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Urbanization in Africa: Challenges and opportunities for conservation

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3 1 **Urbanization in Africa: Challenges and opportunities for conservation**
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50 22 **Abstract**

51 23 Africa, a continent exceptionally rich in biodiversity, is rapidly urbanizing. Africa's urbanization is
52 24 manifest in the growth of its megacities as well as that of its smaller towns and cities. The conservation
53 25 planning and practice will increasingly need to account for direct and indirect impacts of the continent's
54 26 urbanization. The objective of our study is to pinpoint the outstanding challenges and opportunities
55 27 afforded by the growing cities on the continent to the conservation goals and practices. While these
56 28 issues have previously been addressed in many studies they tended to focus on specific issues. Here, we
57 29 provide a synthesis of these supported by new analysis. Urban areas, growing both in population and in
58 30 land cover, pose threats to the integrity of the continent's ecosystems and biodiversity but their growth
59 31 also create opportunities for conservation. The burgeoning urban populations, especially in Sub-Saharan
60 32 Africa, increase the strain on already insufficient infrastructure and bring new governance challenges.
61 33 Yet, Africa's ecosystems can serve as foundations for green infrastructure to serve the needs of its urban
62 34 populations while safeguarding fragile biodiversity. Overall, while worsening social problems
63 35 overshadow the concerns for biodiversity there are also promising initiatives to bring these concerns
64 36 into the fold to address social, institutional, and ecological challenges that emerge with the continued
65 37 urbanization of the continent.

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4 38 **Keywords:** urban growth, sustainability, urban planning, development, biodiversity, ecosystem services,
5 39 land use, land change
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1. Introduction: Urbanization trends in Africa

Africa's move into the "urban age" is projected to be without precedent in its swiftness. While the continent is still largely rural, it is one of the fastest urbanizing regions around the world. Africa's urban population is expected to more than triple over forty years, from 395 million in 2010 to 1.339 billion in 2050, corresponding to 21% of the world's projected urban population [1]. Currently, the continent has seven megacities, that is cities with populations over 10 million: Cairo, Kinshasa, Lagos, Accra, Johannesburg-Pretoria, Khartoum, and Nairobi. In fifteen years, Luanda and Dar es Salaam will be added to this list.

Natural increase is estimated to be a more dominant factor in the increase in urban populations in many African countries compared to migration [2, 3]. Urbanization projections indicate a slowing rate in Africa from the 1990's high rates of up to 8% down to a range of 1.9% - 2.2% from 2020 to 2050, with significant variation across countries [3]. The total population in the continent is projected to reach almost 2.5 billion people by 2050 with about 55 percent living in urban areas (Fig. 1). This is a significant increase given that less than 10 percent of Africa's population resided in urban areas in 1950. Most of the increase in urban population is taking place in small- and medium-sized cities in mid-latitude Africa. The growth of existing villages and towns is also transforming rural landscapes into urban areas [4, 5].

Yet, despite clear physical evidence of urbanization, it must be noted there are large uncertainties in Africa's population projections [6]. National censuses, demographic and health survey data, and population databases are sources of population projections, and each of these have significant uncertainties. Some of these are inherent to survey and census data, but these errors or omissions are amplified in a continent where institutions to collect and store these data are often underfunded and understaffed. Nevertheless, it is clear that the growth of small and medium cities, some of which were previously not designated 'urban', is a major contributor to higher levels of urbanization [4]. The nature of spatial expansion and growth of smaller settlements will significantly influence Africa's urban landscape and its ability to achieve targets associated with the 2030 Agenda set out by the United Nations (UN) [7] and the continent's own vision for Africa in 2063 [8].

Despite high rates of urban population growth, many African countries still have a high degree of urban primacy. That is, one city—usually the capital—has the population, economic activity, and political power that are several times greater than the next largest city. In the context of conservation, because governance and institutions are also concentrated in a single city, there is often disproportionately less attention given to, and resources available for, governing other urban centers, towns, and villages throughout the country. This concern with the overall structure of the urban system is what led the African region to—successfully—push, in the Habitat III process, for a focus on cities and also the national territorial system [9].

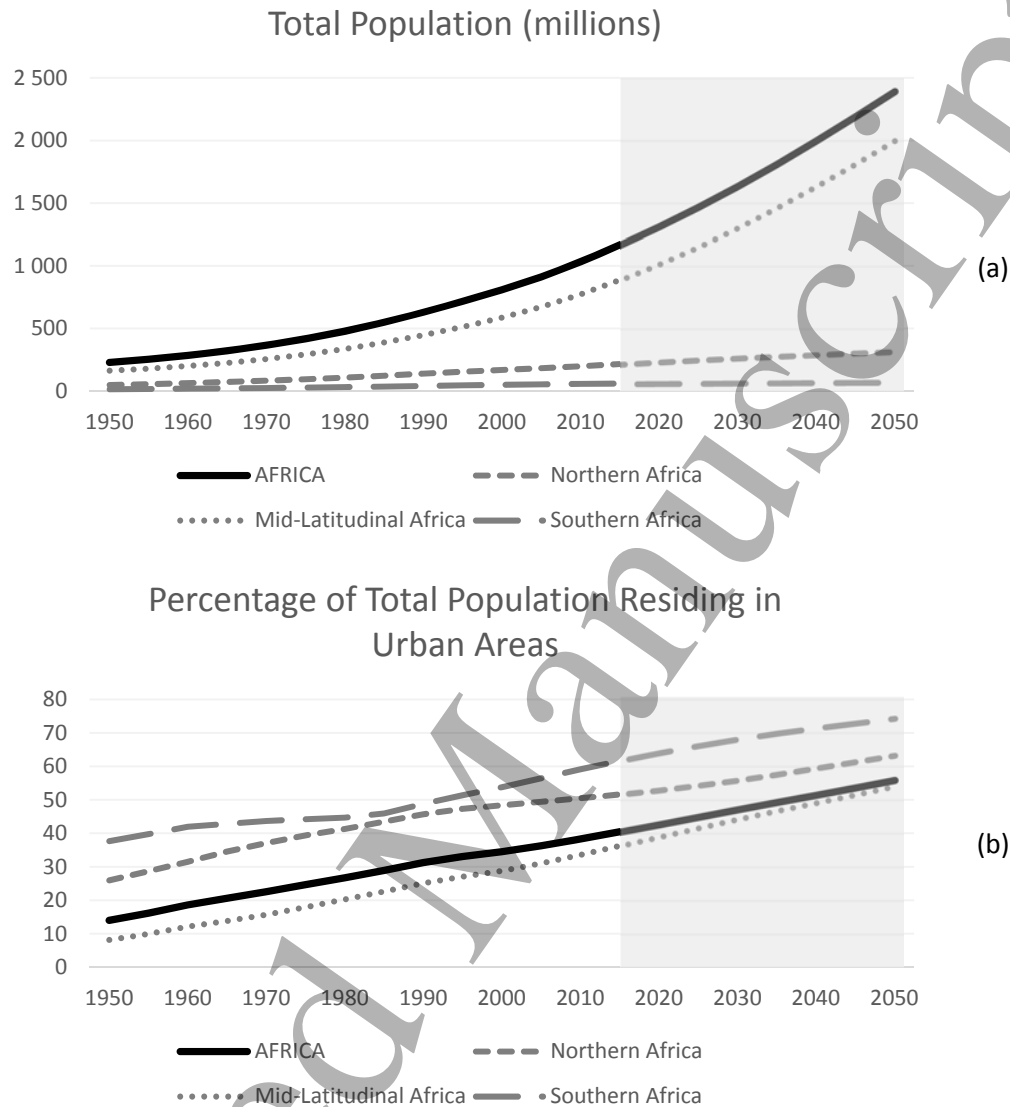


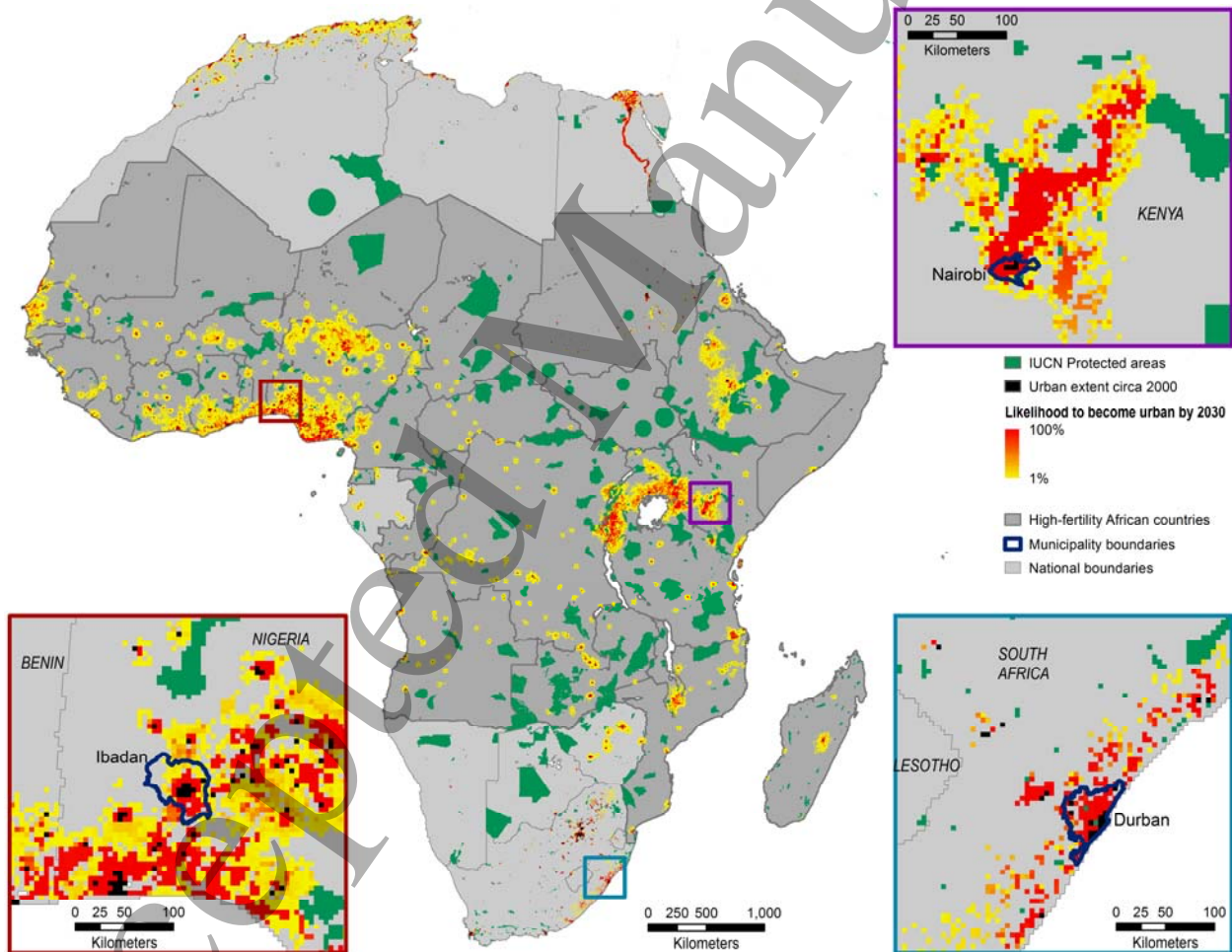
Fig. 1 Historical trends and future projections for total population (a) and percentage of total population living in urban areas (b) in Africa and its three regions. The regions are based on United Nations (UN) regional categorization; Mid-latitudinal Africa is Western, Middle, and Eastern Africa regions. Grayed-out areas represent the projection interval. Data are from United Nations' World Urbanization Prospects, 2014 Revision [1].

Although Africa's high urbanization rates make it similar to other rapidly urbanizing places, it is important to underscore that the underlying processes that shape urbanization in Africa are vastly different from those experienced elsewhere. Much of urban expansion in Africa is characterized by unplanned and unregulated growth, exacerbated by the legacy of colonialism, structural adjustment, and neo liberalism that spawned weak urban planning institutions [10]. In urban areas, unemployment rates are high and about 60 percent of jobs are in the informal or grey economy, neither taxed nor monitored by the government [3]. Hence, Africa's GDP tends to underestimate the amount of economic activity. There are also informal modes of social protection [11] and unregulated land markets, infrastructure and service provision [12]. Complicated settlement-governance arrangements, with weak local authorities and poor land-use management capacity mean that, even while there are examples of

90 extreme density in 'slums' and informal settlements, the overall African urban form is low density [13].
 91 Unregulated peri-urban construction, often by the urban middle classes or expatriates, has spawned
 92 low-rise sprawl or the suburbanization of the countryside, c.f. [14].

93 The increase in urban population in Africa will be accompanied with an expansion in urban land.
 94 Between 2000 and 2030, urban land in Africa is forecasted to increase by nearly 600% [15] (Fig. 2). The
 95 forecasted urban expansion in the continent is concentrated in five regions: the Nile River in Egypt, the
 96 coast of West Africa along the Gulf of Guinea, the northern shores of Lake Victoria in Kenya and Uganda
 97 and extending into Rwanda and Burundi, the Kano region in northern Nigeria, and greater Addis Ababa,
 98 Ethiopia. Except the Nile River, all four regions are located in countries that are identified among the
 99 high-fertility African countries by the UN [16] (Fig. 2).

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102 **Fig. 2** Probabilistic forecasts of urban expansion by 2030 in Africa. We estimate the probability for each location by calculating
 103 the percentage of 1,000 spatially explicit simulations of urban growth, in which that location becomes urban. We generated the
 104 1,000 simulations using Monte Carlo techniques (see [15, 17] for details). Probabilities vary from 1% to 100% from yellow to red
 105 on the maps. High rates of urban expansion are expected along the Nigerian coast (a) and within the Lake Victoria Basin (b).
 106 Even in relatively lower-fertility countries such as South Africa, major urban centers are expected to grow well beyond their
 107 current municipal boundaries (c).

2. Urbanization impacts on African biodiversity

Africa has several regions with exceptional biodiversity [18] and is dotted with protected areas (PAs) with varying levels of protection status. The PAs cover an area of about 4.5 million km² across the continent [19]. As recently as 2000, Africa was sparsely urbanized with only about 500 km² of urban land within the boundaries of its PAs (Table 1). In contrast, by 2030, total urban extent within 50km of PAs on the continent is expected to reach more than 140,000 km². In particular, the urban areas in the mid-latitudinal Africa, with several high-fertility countries, are expected to increase by over 100,000 km². This nearly 20-fold increase in urban extent, the largest forecasted proportional increase in the vicinity of PAs across the world [17], will pose especially acute challenges for governance and management of PAs and the surrounding lands in this region.

Table 1. Total urban land in PAs in 2000 and forecasted change in urban land within 50km of PAs in Africa from 2000 to 2030.

Region*	Urban in PAs in 2000 (km ²)	Urban in 50km of PAs (km ²): average (std dev)			Percent Increase in Urban in 50km of PAs: average (std dev)	
		Year 2000	Year 2030			
Northern Africa	125	2,800	14,182	(2,518)	407	(190)
Mid-latitudinal Africa	300	5,425	107,110	(20,862)	1,874	(485)
Southern Africa	100	6,875	23,312	(3,194)	239	(146)
Africa	525	15,100	144,604	(25,416)	858	(68)

* Regions are based on United Nations (UN) regional categorization; Mid-latitudinal Africa is Western, Middle, and Eastern Africa regions.

While large urban centers such as Nairobi, Kenya and Ibadan, Nigeria dominate the continent's urban expansion patterns (Fig. 2), the ecological impacts of the smaller cities and towns across Africa are also considerable. This is even the case for smaller cities such as Gaborone and Windhoek, the capitals of, respectively, Botswana and Namibia. Both cities are located in resource-poor areas and experience recurrent severe shortages of water [20]. Gaborone, with a population of 232,000 in 2011 [21], relies, in part, on water supplied from the Letsibogo Dam on Motloutse River, via a 400km long pipeline. An extension of this North-South Water Carrier is planned that will bring waters from the Zambezi River—about 500km from Gaborone—to the relatively small but growing city. Such long-distance water transfers are likely to become more widespread as growing cities in Africa will seek new sources to meet their increasing demand for water [22].

It is often assumed that migration from rural to urban areas and the resulting concentration of populations in cities would ease the pressure on natural habitats. In many parts of the Sub-Saharan Africa, the migration and subsequent concentration of people in urban areas has indeed reduced rural populations, thus leading to reduced rates of deforestation [23]. However, land speculation by wealthy urban residents has also driven—abetted by lack of land-use planning and control—loss and fragmentation of rangelands close to cities and towns in Ethiopia, Kenya, and Uganda [24]. In Western Africa, the increased demand for food in the cities has incentivized farmers to convert forests to agricultural fields to meet this demand [25]. These examples suggest that any relief from pressure on habitats from rural-urban migration may be overtaken by the increased demand for food and other

139 natural resources from rapidly growing African cities. Furthermore, there are many instances of
140 increasing deforestation in spite of an increase in a country's urbanization level as more complex
141 dynamics –often involving long-distance actors- start to play more prominent roles [26, 27]. Importantly,
142 there has been significant foreign direct investment (FDI) directed at land purchases in the continent to
143 help secure food production for urban residents in other parts of the world [28]. Therefore, conclusive
144 evidence on ecological outcomes of rural-urban migration on the continent is yet to materialize [25].

145 Urbanization and economic development also drive expansion of the transportation network, which in
146 turn often fragment habitats. Of particular concern in the context of biodiversity conservation are the
147 road and railroad infrastructure. Across Africa, there are 33 major development corridors, either
148 proposed or already under construction [29]. If and when constructed, the road and railroad
149 infrastructure in current plans would cut through over 400 PAs and could degrade about 2,000 more.
150 Moreover, large-scale changes in transportation networks such as the one proposed around the
151 Serengeti may significantly influence future urban expansion patterns potentially increasing the
152 vulnerability of PAs [30, 31].

153 Another example for the far and wide-reaching impact of urban residents is the bushmeat trade [32, 33].
154 Demand for bushmeat, a traditional source of animal protein for humans in much of Sub-Saharan Africa
155 is on the rise fueled by dietary preferences of urban residents that are shaped by a combination of
156 urbanization and increased-income effects [34]. It is shown that the high levels of human density,
157 characteristic of urban and peri-urban areas, are negatively correlated with bushmeat from ungulates
158 and primates sold in markets [35]. However, the bushmeat trade is also linked to rural livelihoods [36].
159 Therefore, measures such as blanket bans are likely to be an ineffective approach to address this
160 complex issue; a more balanced approach that safeguards sensitive species as well as the livelihoods of
161 people that rely on bushmeat trade, and one that recognizes the role of bushmeat in providing nutrition
162 to millions of people along the urban-rural spectrum is needed.

163 The negative impacts of urbanization are evidenced in the expanding haloes of deforestation around
164 cities and transportation routes [37]. Such exploitation of natural resources in expanding waves,
165 progressively from the most highly valued to less, is observed both in large cities [38] and around
166 smaller settlements [39]. Peri-urban agriculture, though important for food security in many sub-Sharan
167 African countries, can also contribute to loss and degradation of habitats around cities. Environmental
168 degradation spreading out from an urban center can be significantly enhanced in both speed and
169 intensity depending on the state of the transportation network [23, 37]. In the near future, the regions
170 that may experience such degradation most rapidly and extensively are eastern and southern
171 Democratic Republic of Congo (DRC) and southern Cameroon, due to their high rural population
172 densities and high foreign demand for agricultural lands [37].

173 Ethnic conflicts and civil wars, some of which have been going on for decades, also influence
174 urbanization in several parts of the continent. Such conflicts, as an underlying driver of urbanization,
175 have arguably the most prominent influence on the biodiversity in central African countries [37]. The
176 challenges faced by habitats in peri-urban areas around major cities can be intensified to the extent that
177 refugees and internally displaced people (IDP) settle in informal settlements around the peripheries of

178 these cities [40]. In particular, in East Africa and the Horn of Africa, an increasing number of refugees
179 and IDP are living in cities [41]. All these add to the challenges faced by the governments of these cities.
180 Furthermore, what has started as a temporary camp for refugees and IDP may morph into urban areas
181 over time whose demand for natural resources such as fuelwood, building materials, fresh water, and
182 wild foods can be immense and result in significant local environmental degradation [42].

183 Influences external to the continent play significant roles in shaping the impact of the urbanization on
184 the biodiversity and ecosystems. Some of these are financed by foreign direct investment (FDI) from
185 countries outside Africa, i.e., increasingly from China, India, Malaysia, and Brazil in addition to Europe
186 and the USA that have been historical sources of FDI to the continent [40]. In recent years, investment
187 from another rapidly urbanizing country, China, has been an important source of funding for
188 infrastructure projects in the continent. How to ensure that such investments facilitate industrial
189 diversification and urban development on the continent without accelerating the decimation of Africa's
190 ecosystems is an outstanding challenge [29, 40]. Demand for animal parts as food, as ornament, or
191 medicine has also been on the rise with the increasing levels of income and integration with global
192 markets in those countries where such demand originates. These influences interact with those internal
193 to the continent to shape urbanization patterns, habitat loss and fragmentation, and loss of biodiversity
194 [25, 43].

195 **3. Including an urban perspective for ecological governance and conservation and vice versa**

196 Ecological governance envisions the inclusion of ecological knowledge, science, and principles in all
197 levels of decision-making, development planning, and implementation. Implicit in this view is that there
198 is adequate ecological knowledge at all levels of decision-making from the individual communities
199 through continental scales. In this respect, two of the major limitations in Africa with regard to
200 ecological governance are the lack of capacity and lack of involvement of ecological experts in policy
201 decisions. Multilateral environmental agreements scarcely include an ecological perspective even if it is
202 increasingly recognized that decisions in economic, social, and political spheres will have major impacts
203 on ecosystems. Furthermore, urban areas are integral to ecological landscapes; ecosystem processes
204 and services change in character along a rural-urban continuum but do not cease to exist towards the
205 urban end. This provides a good case for extending the management of natural resources beyond the
206 confines of contemporary protected-area-based conservation [25].

207 While there has been an increasing realization of the dependency of humans on ecosystem services [44],
208 this realization does not seem to have had any influence in national or regional policy positions on
209 urbanization in Africa. One reason for this is that, although the regional interest in knowledge about
210 ecological landscapes in urban areas is growing [45, 46], both conservation scholarship and practice still
211 largely ignore urban areas and fail to see them as integral parts of the landscape. One exception is South
212 Africa where the concept of ecosystem services has been put to use both at the national and sub-
213 national level to explore strategies for sustainable water resource management [47]. One of the sub-
214 national projects focus on Olifants Grassland Catchment that includes major urban centers and heavy
215 industry but is also home to Kruger National Park. In this project, scenario analysis and green-

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3 216 infrastructure planning were employed to simultaneously manage demand for water and preserve
4 217 biodiversity by giving explicit attention to ecosystem services.

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7 218 The challenges that urban areas in Africa are facing are among the biggest in the world. The provision of
8 219 basic urban services has already been lacking across most cities on the continent even before the latest
9 220 surge in urbanization. The reasons for poor governance and inadequate service infrastructure in urban
10 221 areas can be traced back to colonial institutional arrangements and persistent political instability [25].
11 222 Some African countries do not have any urban planning and development departments while the rigid
12 223 zoning in central areas of many cities inadvertently contribute to proliferation of slums and sprawling
13 224 development of residential areas [25]. The social problems are liable to further deteriorate as the
14 225 demand for services and the cost for delivery both rise jeopardizing achieving even the minimum targets
15 226 of the Millennium Development Goals. Under these conditions, it is especially hard for the responsible
16 227 agencies to put due emphasis on biodiversity conservation. Nevertheless, there is a practical aspect for
17 228 urban planning and governance to heed conservation of the habitats and biodiversity [48].

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22 229 Studies on the interactions among biodiversity, ecosystem services, and urbanization conclude that they
23 230 are multifaceted and elude simplification [49, 50]. This complexity poses both opportunities and
24 231 challenges for conservation in urban landscapes. While it is hard to accurately value the services
25 232 provided by ecosystems there are promising developments towards valuation of these resources to
26 233 inform their sustainable and equitable management [51]. One problem in the case of African cities, as in
27 234 most other developing country cities, is the lack of data to generate these monetary valuation estimates
28 235 [52]. A more fundamental problem is that many of these services are common or public goods. This
29 236 means that benefits they provide are not necessarily limited to those who can pay for them, but are
30 237 typically freely available to a larger group [48].

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35 238 Conservation has implications for ecosystem services [53]. African cities can benefit from ecosystem
36 239 services such as provision of clean air and water while developing their economies [9]. In this sense,
37 240 riparian zones can serve as critical parts of green infrastructure for purposes such as protection from
38 241 floods, provision of recreational spaces, and cleaning water while safeguarding biodiversity. Including
39 242 riparian zones along with non-riparian areas within a system of urban parks is especially important to
40 243 reflect maximum heterogeneity in native vegetation types [54]. Therefore, valuation of services
41 244 provided by these ecosystems need to be given due attention in urban development initiatives [55]. The
42 245 potential value of biodiversity and ecosystem services as foundations for a green infrastructure to meet
43 246 the demands of urban residents has been showcased in a study on Johannesburg [52]. In this sense,
44 247 urban agricultural plots can be used to increase green cover and enrich biodiversity in urban areas while
45 248 improving food security and overall socio-economic condition of urban residents [56]. For this to
46 249 happen, more attention needs to be given to the extent urban agriculture contributes to enhanced
47 250 biodiversity in African cities and towns [57, 58], which has been a relatively lesser studied aspect of
48 251 urban agriculture [59].

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54 252 Africa has recently adopted its own new urban agenda, in which cities are seen as drivers of
55 253 development and keys to future prosperity of the continent. The African Urban Agenda (AUA), a UN-
56 254 Habitat initiative to facilitate sustainable urbanization practices in the continent [9], provides an

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3 255 opportunity to incorporate ecological governance and conservation into urban governance and
4 256 planning. The AUA program does not make any explicit reference to biodiversity and ecosystems [8] but,
5 257 by providing a framework for African governments to address urbanization challenges with an emphasis
6 258 on urban resiliency, regional integration, and quality of life of urban residents, it presents potential entry
7 259 points for biodiversity conservation to be integrated in broader urbanization strategies across the
8 260 continent. Should such strategic integration takes place, however, coordination among governments
9 261 across local, regional, and national levels would be essential for the efficient management of ecosystem
10 262 services and conservation of biodiversity through regulatory mechanisms and infrastructure systems.

11 263 The participation of three African countries, Botswana, Madagascar, and Uganda, in the WAVES (Wealth
12 264 Accounting and Valuation of Ecosystem Services) initiative is expected to increase the awareness of the
13 265 value of ecosystem services to natural economies. WAVES is a World Bank-led global partnership to
14 266 ensure that natural resources are explicitly recognized in development planning as natural capital [60].
15 267 To the extent that the partnership is successful in its aim of mainstreaming natural capital in
16 268 development planning, it can lead the participating countries to devote more effort to ecological
17 269 governance and serve as role models for others in the continent to follow. However, the links to
18 270 governance and infrastructure planning in urban areas where most people will live and where most
19 271 demand for these services will originate are currently missing in this initiative; such links are also
20 272 somewhat muted in larger deliberations about the future of African cities [9].

21 273 Integrated Land-Use Planning initiative of International Union for Conservation of Nature (IUCN) in four
22 274 countries (two of which, Tanzania and Zambia, are in Africa) presents an opportunity to achieve more
23 275 sustainable management of urbanization and improved biodiversity conservation through spatial
24 276 planning [61]. Finally, Lake Victoria Environmental Management Program (LVEMP II) is a regional
25 277 initiative formed by the local governments of the countries within the basin of Lake Victoria [62]. While
26 278 agricultural conversion appears to be the biggest threat [31], with the economic development of the
27 279 larger Lake Victoria Region and population increase, urban areas especially in the countries that
28 280 surround Lake Victoria (Uganda, Tanzania, and Kenya) increasingly place an undue burden on the lake.
29 281 One of the goals of the LVEMP II initiative is rehabilitation of the lake's ecosystems on which livelihoods
30 282 of millions of people depend. Several other freshwater ecosystems in Africa face similar challenges that
31 283 require international and inter-urban collaboration [40].

32 284 Supra-national or regional bodies have the potential to contribute to ecological governance in Africa,
33 285 though understandably given Africa's economic challenges, much of the current focus is on
34 286 opportunities that urbanization can deliver for structural transformation [8]. For example, the African
35 287 Union (AU) is the continental body responsible for giving direction to various policies in Africa –
36 288 including economic development. The AU-affiliated African Ministerial Conference on the Environment
37 289 (AMCEN), is tasked with providing continent-wide leadership by promoting awareness and consensus on
38 290 global and regional environmental issues, especially those related to international conventions on
39 291 biodiversity, desertification, and climate change. Another AU-affiliated body, the African Ministers'
40 292 Council on Water (AMCOW) provides political leadership, policy direction, and advocacy in the
41 293 provision, use, and management of water resources for sustainable social and economic development
42 294 and maintenance of African ecosystems.

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3 295 An important consideration for any of these initiatives is the quality of data. In studying the interactions
4 296 of urban areas and biodiversity, not only the uncertainty in future rates and patterns of urban expansion
5 297 but also the uncertainty in PA and other critical-habitat boundaries need to be considered. The
6 298 uncertainty in these boundaries may be significant due to errors and biases in the selection of
7 299 biodiversity indicators, species ranges, and ecological processes [63-65]. Consequently, PA extents do
8 300 not necessarily overlap with the ranges of species that are in need of conservation [66]. On the other
9 301 hand, there are inherent uncertainties in future projections and forecasts of growth in urban
10 302 populations and urban land [2, 17, 67]. All these uncertainties have implications on the governance of
11 303 sensitive habitats and confound attempts to reconcile urbanization and biodiversity conservation on the
12 304 continent. Further, the interactions between urbanization and ecosystems are subject to the influence
13 305 of any significant changes in regional and continental climate. These changes may play out through
14 306 changes in ecosystem processes, in species adaptation, and in intensification of socio-economic
15 307 pressures. The efforts by many agencies and universities to better understand the drivers and impacts of
16 308 climate change across Africa may produce useful information on how these influences may unfold in
17 309 different parts of the continent over the next few decades [68, 69].

24 310 **4. Conclusion**

26 311 Encroachment of urban areas towards natural habitats and increasing demands of growing urban
27 312 populations on natural resources put direct and indirect pressures on ecosystems. Notwithstanding the
28 313 physical expansion of urban areas, concentration of people in urban areas would seem to ease off the
29 314 pressure on natural habitats; yet, the effect of urban residents can be far and wide-reaching, e.g.,
30 315 through extension of transportation network, transfer of water over long distances, and increased
31 316 demand for bushmeat. Urbanization in Africa, if well managed, can act as a catalyst to move the local,
32 317 regional, national, and international governance mechanisms in the continent towards more effective
33 318 conservation of biodiversity. The continent, having several regions with exceptional biodiversity, has
34 319 much to offer to its urban populations in terms of recreation, a legacy of natural history, and a source of
35 320 national pride. Its biodiversity and ecosystems can also serve as foundations for green infrastructure
36 321 that can meet the needs of burgeoning urban populations while not ravaging these very ecosystems on
37 322 which both rural and urban livelihoods ultimately depend.

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